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Accomplishment (800 characters):

(1) We developed and fabricated a modified target design integrating the laser wakefield acceleration gas cell design with an angled foil holder for proton beam generation via target normal sheath acceleration (TNSA). (2) The experiment was conducted at the JLF using the Callisto laser. Diagnostics for measuring TNSA proton beam characteristics were set up including RCF stacks, Thomson parabola and imaging plates (3) The self-guiding length in the gas cell for optimized contrast enhancement was estimated to be ~4mm and compared to experiment. Beam emission characteristics were improved using our new design. (4) Preliminary data analysis were performed, detailed analysis and comparison to simulations are underway.

Project Summary Statement (800 characters):

Target normal sheath acceleration (TNSA) by self-guided laser pulses is demonstrated at a range of Al target thickness (2-10 microns), and proton spectra are compared with those accelerated by un-guided laser pulses. For un-guided pulses, the maximum proton energy decreases with the decrease of target thickness, exhibiting the detrimental effect of laser pre-pulse on TNSA. On the other hand, the dependence of proton energy on target thickness was not observed when using self-guided laser pulses, which is possibly due to the suppressed pre-pulse intensity. However the laser pulse appears to lose a significant amount of energy (>~50%) during ~4mm self-guiding in the plasma, and thus the accelerated proton energy is much lower than the case of unguided pulses.

Next Step (one sentence):

We will continue developing this contrast enhancement technology by increasing the laser energy throughput while keeping the low prepulse intensity. This requires better understanding in the relativistic self-guiding process via further experimental and simulation works. This study will have an impact on the understanding of laser prepulse on TNSA.